

TV White Space

DOE

Spectrum Technology Workshop

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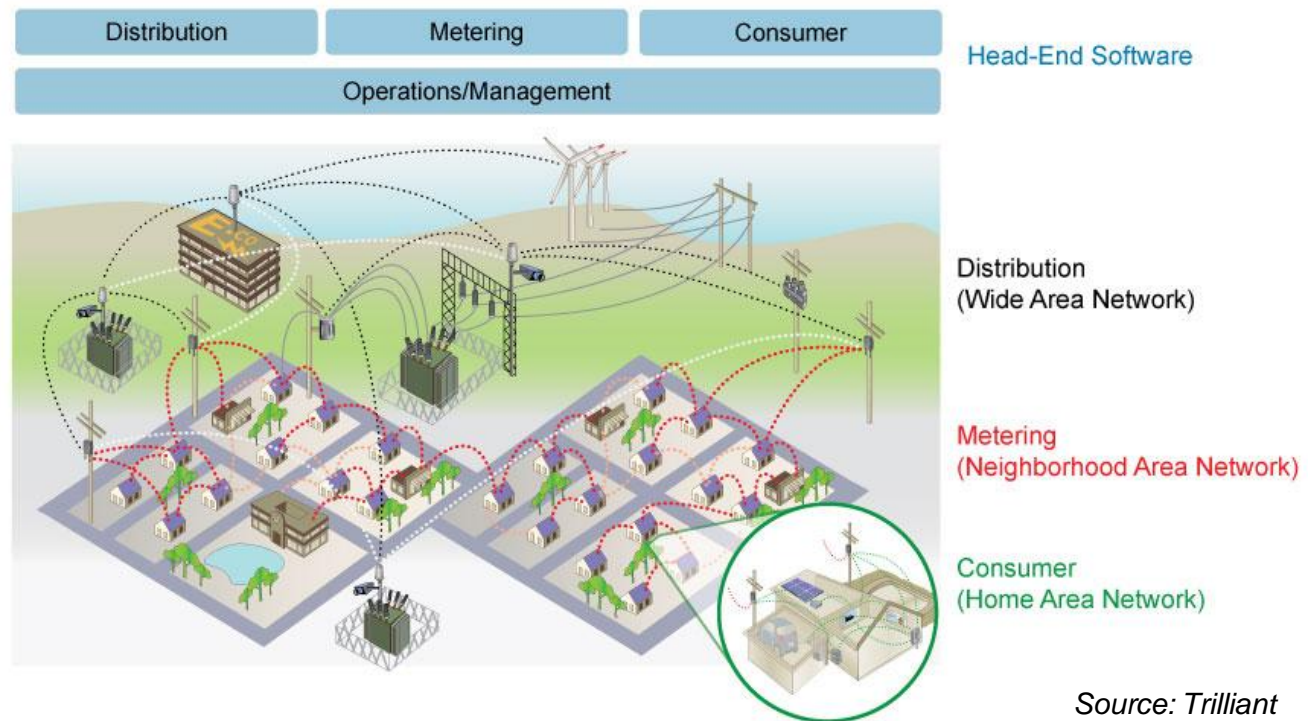
COMMScope®

Topics

- Background
- What is “White Space”
- Applications
- Issues
- Wrap-up

Background

- Smart Meter Deployment (Pike Research)
 - 200M worldwide
 - 40M North America
- Utilities are realizing cost savings from smart meters due to features such as remote disconnect and efficient meter reading



What is “White Space”



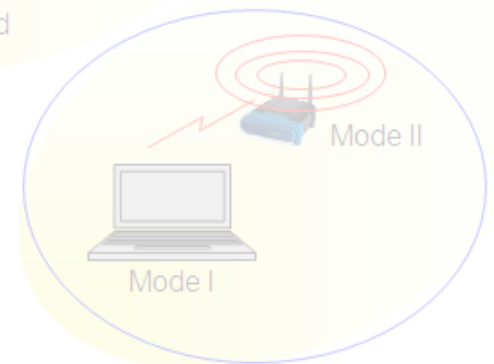
Fixed



Fixed



Mode II



Mode I

Mode II

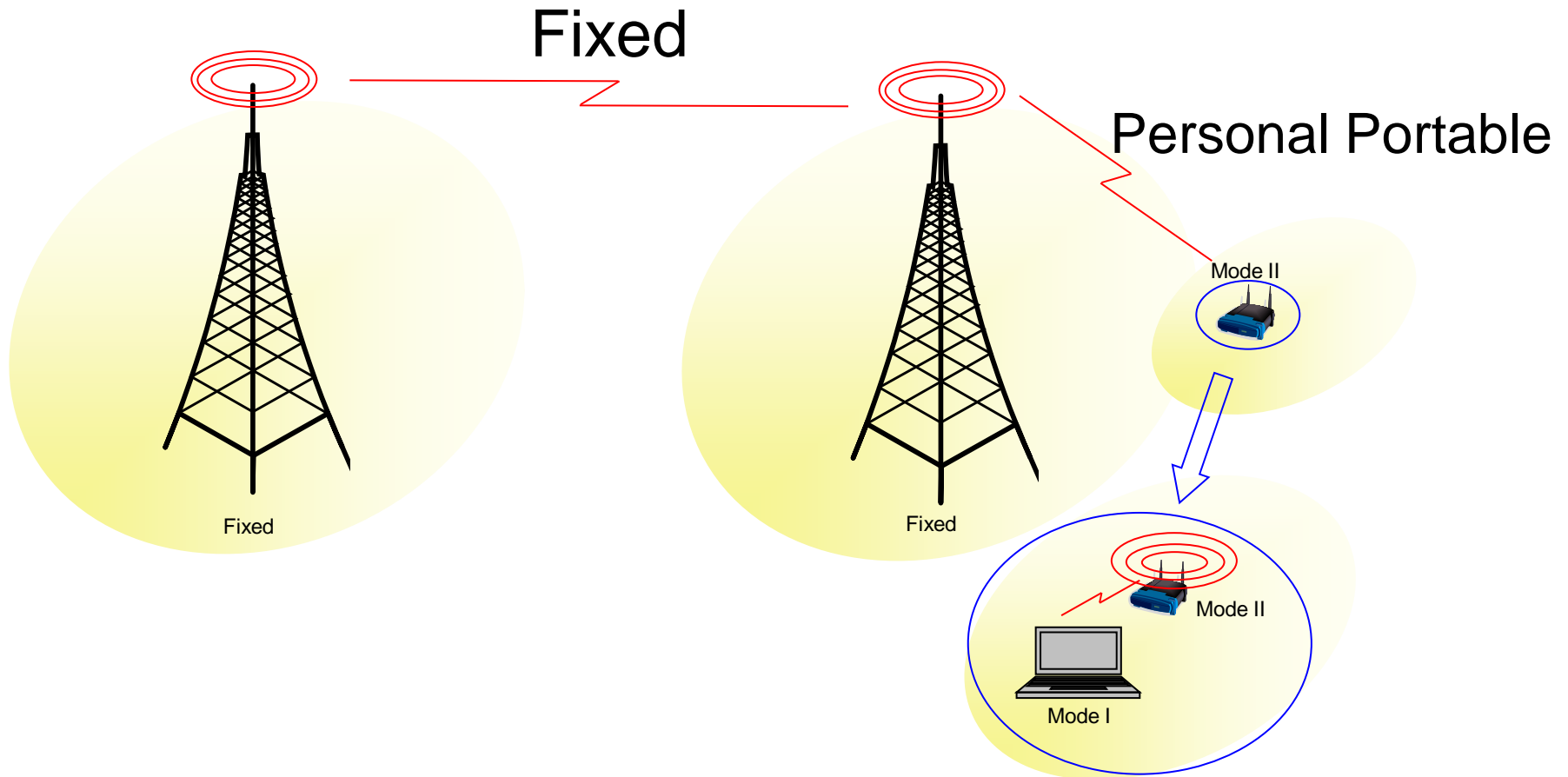
Definition

- FCC says: “...unlicensed radio transmitters operating in the broadcast television spectrum at locations where that spectrum is not being used by licensed services...”
- Operating channels determined by a geo-location database (or spectrum sensing)

TV Channels in DC/Baltimore

Ch	Freq		Ch	Freq
2	54–60	← White Space	27	548–554
3	60–66		28	554–560
4	66–72		29	560–566
5	76–82		30	566–572
6	82–88	← White Space	31	572–578
7	174–180		32	578–584
8	180–186		33	584–590
9	186–192	← White Space	34	590–596
10	192–198		35	596–602
11	198–204		36	602–608
12	204–210		37	608–614
13	210–216		38	614–620
14	470–476	← White Space	39	620–626
15	476–482		40	626–632
16	482–488		41	632–638
17	488–494		42	638–644
18	494–500		43	644–650
19	500–506	← White Space	44	650–656
20	506–512		45	656–662
21	512–518		46	662–668
22	518–524	← White Space	47	668–674
23	524–530		48	674–680
24	530–536		49	680–686
25	536–542	← White Space	50	686–692
26	542–548		51	692–698

Two Types of Devices



Fixed Devices

- Permanently installed base station transmitting to one or more fixed devices or to a Personal Portable device
- Max Tx power is 4W EIRP (1W into 6dBi gain antenna, 36 dBm)
- Max antenna height is 30m AGL and 250m HAAT
- Cannot operate co- or adj-channel to existing TV operation
- Must be professionally installed (to get location) OR geolocated
- Geolocation accuracy must be 50m
- Must register in database
- Must use database to provide list of channels available for operation

Fixed Devices

- Must check database at least daily
- Must disable within up to two days if device fails to contact database
- Database will unregister a device if it does not contact the database for three months
- Can receive available channels from another Fixed device
- Device sends available channels to Personal Portable devices associated with it
- Antennas must be outdoor
- Must transmit identifying information

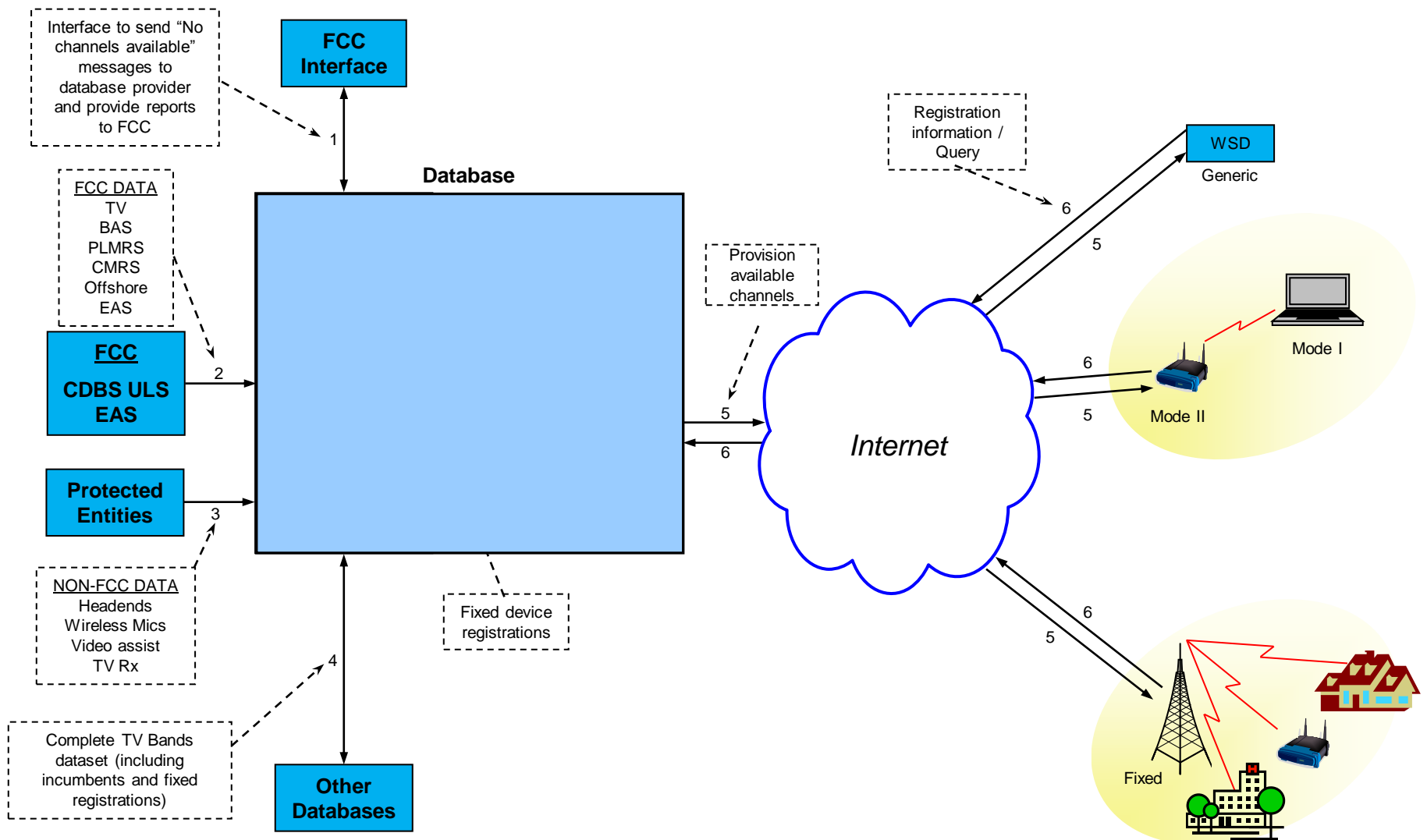
Personal Portable Devices

- Max Tx power is 100 mW EIRP (20 dBm)
- Except 40 mW EIRP (16 dBm) if adjacent to licensed station within protected coverage area
- Don't need to register in database
- Don't need to send basic ID info when operating
- Cannot operate co-channel to existing TV stations
- Cannot operate in TV channels 2 – 20

Personal Portable Devices

- Mode I – client
 - Under control of a Fixed device or a Personal Portable device that employs a geolocation database
 - Receives available channels from Mode I or Fixed
- Mode II – independent
 - Determines available channels on its own using a geolocation database
 - Can get channels from a Fixed Device
 - Must disable if unable to determine location
 - Must access database every 60 sec and every time device moves and at least daily
 - Must disable within a day if device fails to contact database

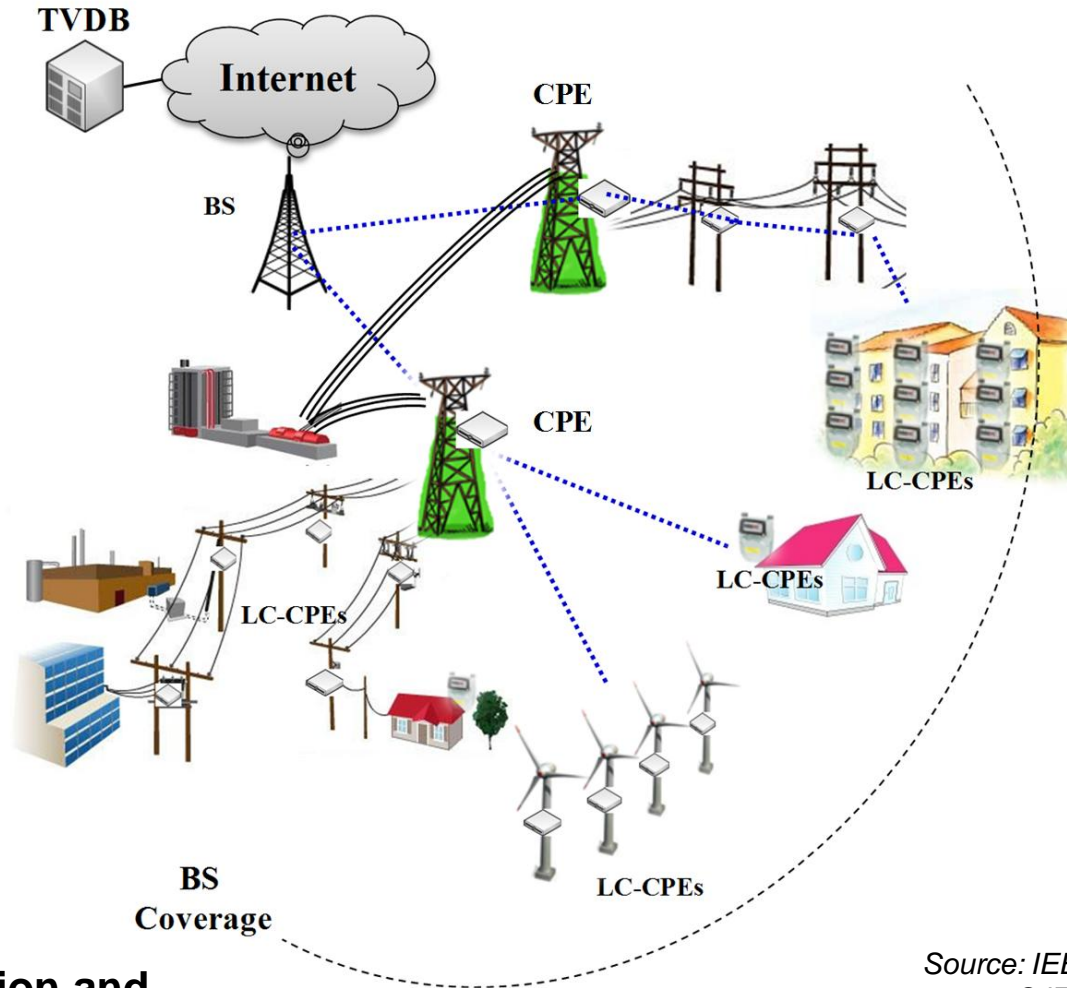
How It Works



Characteristics

- Relatively low frequency means good propagation and building penetration
- Uplink limited
 - Lower power for personal portables
- May be capacity-limited
 - Based upon number of available channels
- Bands are unlicensed
- Some international spectrum harmonization
 - So far, most white space is in VHF/UHF TV bands
- Database concept extensible to other spectrum bands
- Standards-based interfaces

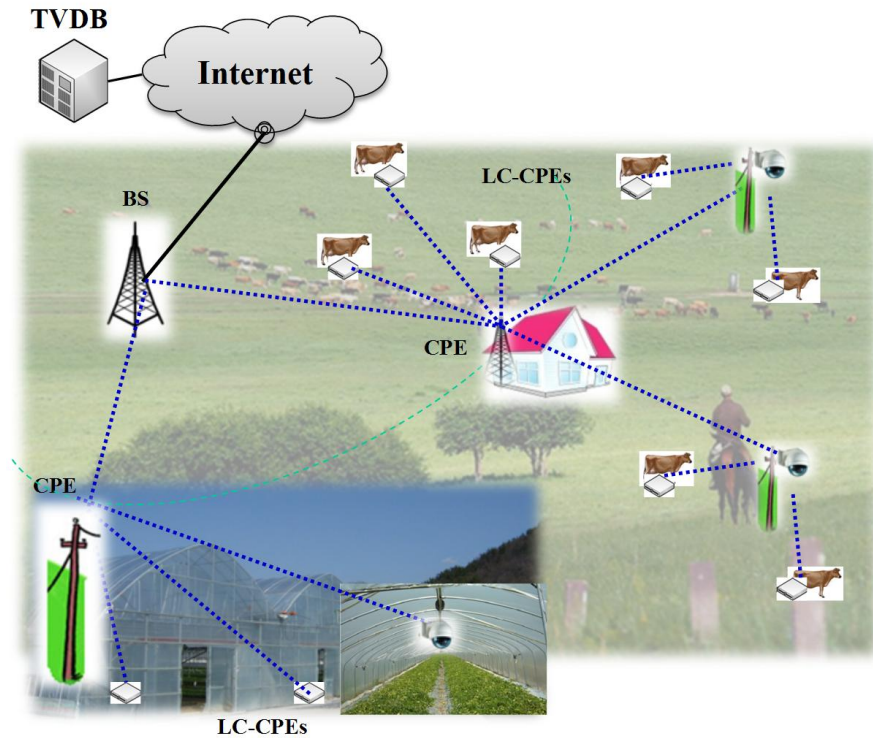
Some Applications



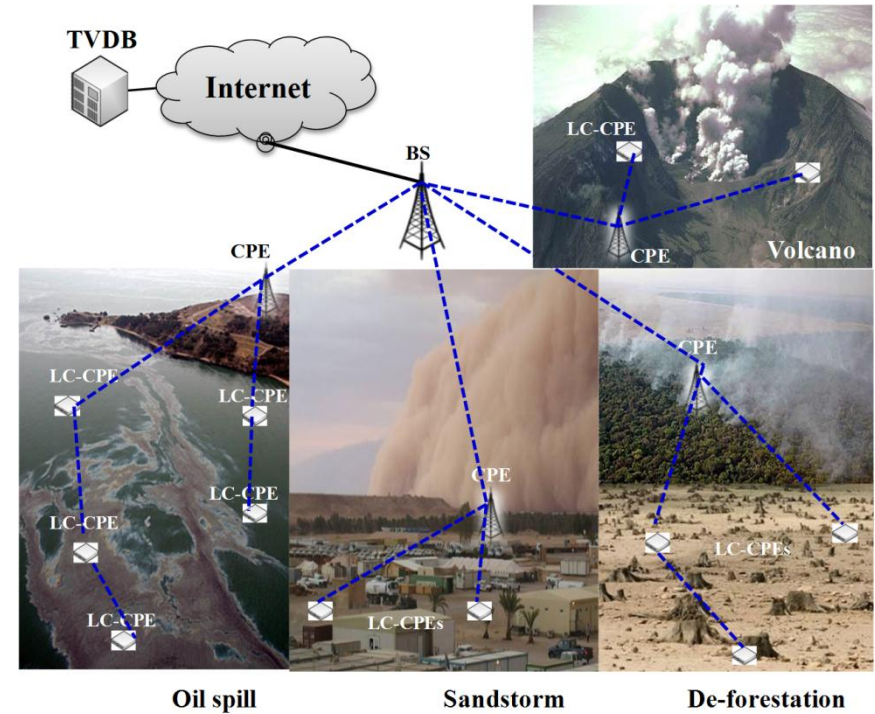
Source: IEEE 802.22
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**Distribution Automation and
Advanced Metering Infrastructure**

Some Applications



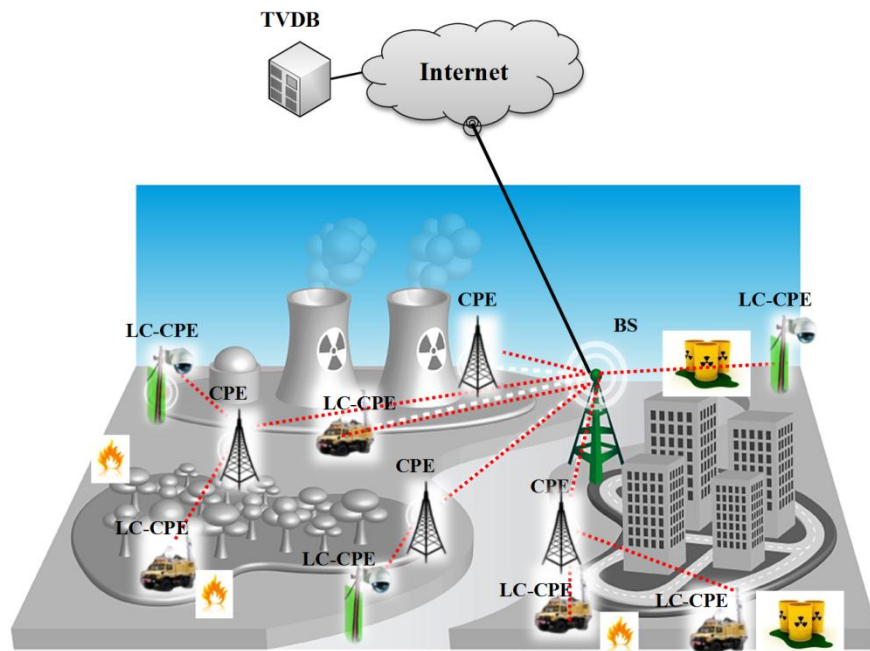
Farm Monitoring



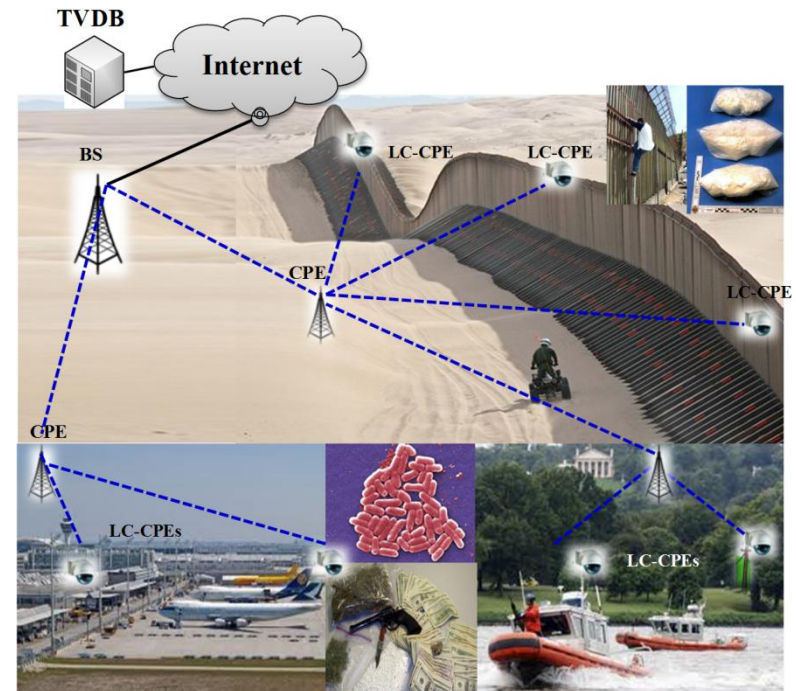
Environmental Monitoring

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Some Applications



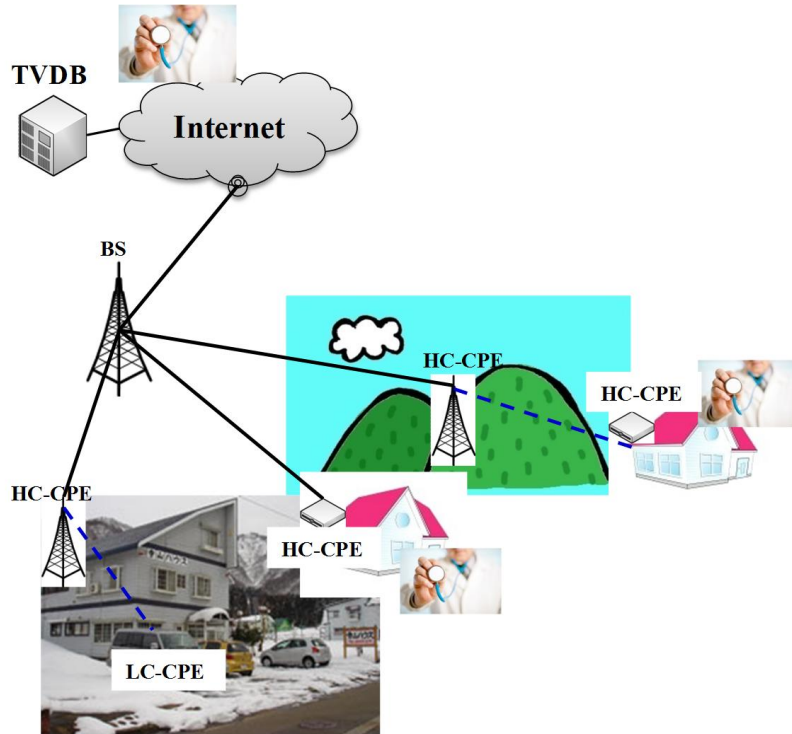
Hazard Monitoring



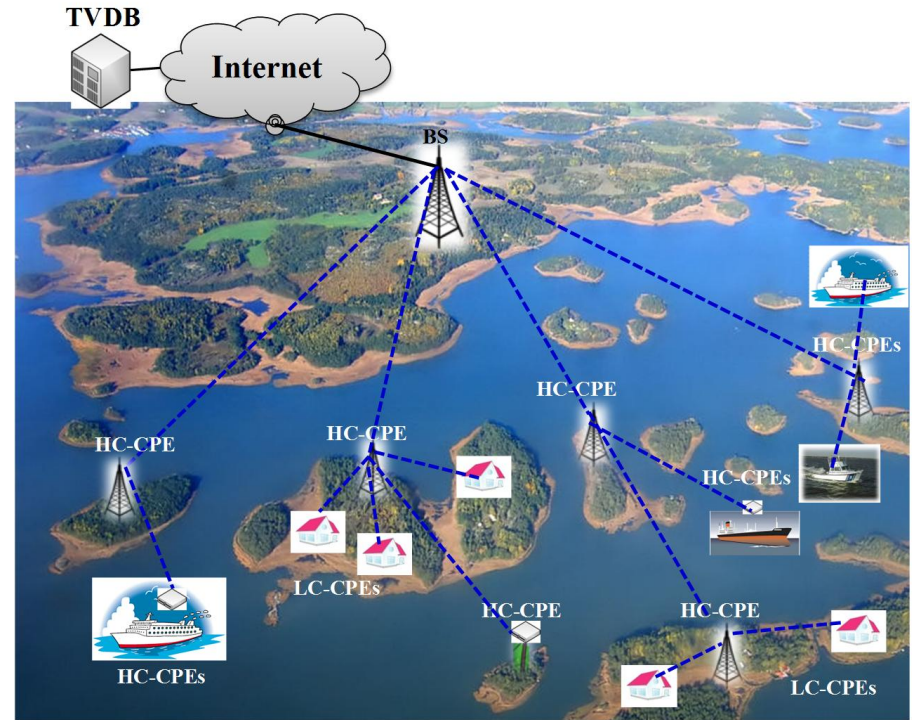
Homeland Security Monitoring

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Some Applications



Remote Medical

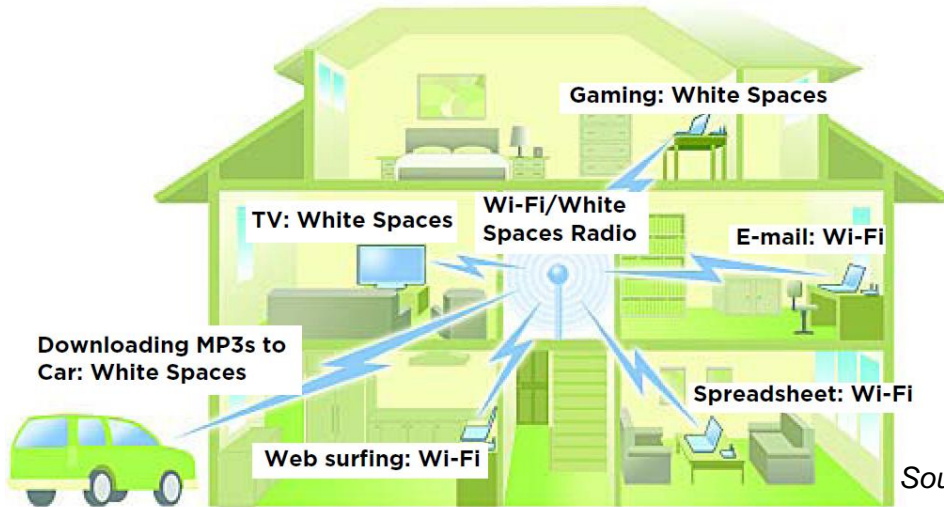


Archipelago/Marine Broadband

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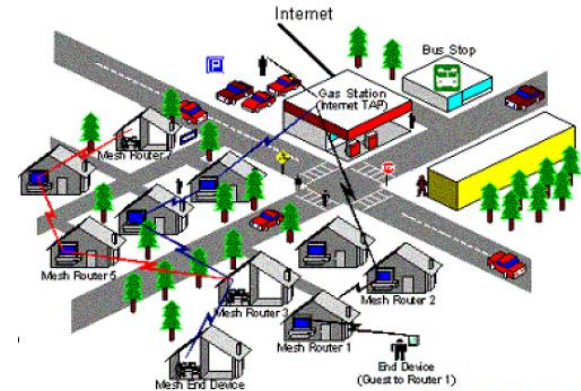
Some Applications

In-home Multi-media Distribution



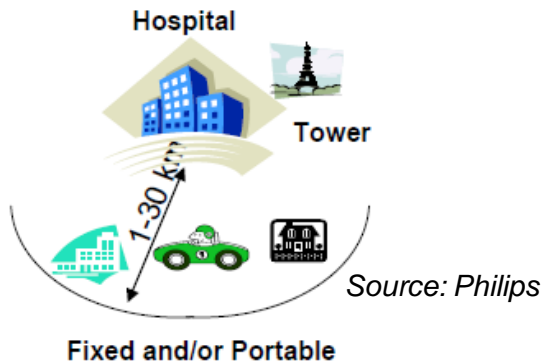
Source: Dell

Neighborhood Networks



Source: Microsoft

Tele-Health (Assisted Living & Elderly Care)



Source: Philips

Fixed and/or Portable

Home Automation & Control



Source: Philips

Low Power Portable

Telephony



Source: Philips

Low Power Portable

Issues

- Relatively new service
- Regulatory concerns
 - Antenna height limitation
 - Power limits
 - Emission masks
- Multiple database administrators (ten)
- Slow international regulatory development
- Few equipment providers
- Middle Class Tax Act of 2012
 - Spectrum re-farming
 - Incentive Auctions

Non TV Incumbents		Ch	Freq	TVBD	VHF-LO
		2	54-60	Fixed Only	
TV Interface Devices		3	60-66	No TVBD	
		4	66-72		
Unlicensed Wireless Microphones		5	76-82	Fixed Only	VHF-HI
		6	82-88		
		7	174-180		
		8	180-186		
		9	186-192		
		10	192-198		
		11	198-204		
		12	204-210		
		13	210-216		
	PLMRS/CMRS in 13 Metro Areas	Offshore Radiotelephone (Gulf coast)	14		
15			476-482		
16			482-488		
17			488-494		
18			494-500		
19			500-506		
20			506-512		
Unlicensed Wireless Microphones		21	512-518	Fixed & Personal Portable	UHF
		22	518-524		
		23	524-530		
		24	530-536		
		25	536-542		
		26	542-548		
		27	548-554		
		28	554-560		
		29	560-566		
		30	566-572		
		31	572-578		
Reserved for Unlicensed Wireless Microphones		32	578-584		
		33	584-590		
		34	590-596		
		35	596-602		
WMTS		36	602-608	No TVBD	
Reserved for Unlicensed Wireless Microphones		37	608-614		
		38	614-620	No TVBD if 36 & 38 not avail	
Reserved for Unlicensed Wireless Microphones		39	620-626		
Unlicensed Wireless Microphones		40	626-632	Fixed & Personal Portable	
		41	632-638		
		42	638-644		
		43	644-650		
		44	650-656		
		45	656-662		
		46	662-668		
		47	668-674		
		48	674-680		
		49	680-686		
		50	686-692		
		51	692-698		

120 MHz

Wrap-Up

- Smart Grid presents new opportunities for White Space.
- Great potential for broadband.
- This is new.
- Success will have applicability to other spectrum.
- Regulatory process has been lengthy, complicated and is still ongoing.
- Is unlicensed spectrum appropriate for critical infrastructure?
- Is there enough spectrum?



Thank You

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